WESTERN AUSTRALIAN HISTORICAL SOCIETY.

# History of the Coolgardie Water Supply Scheme

WESTERN AUSTRALIAN HISTORICAL SOCIETY.

WORTHINGTON

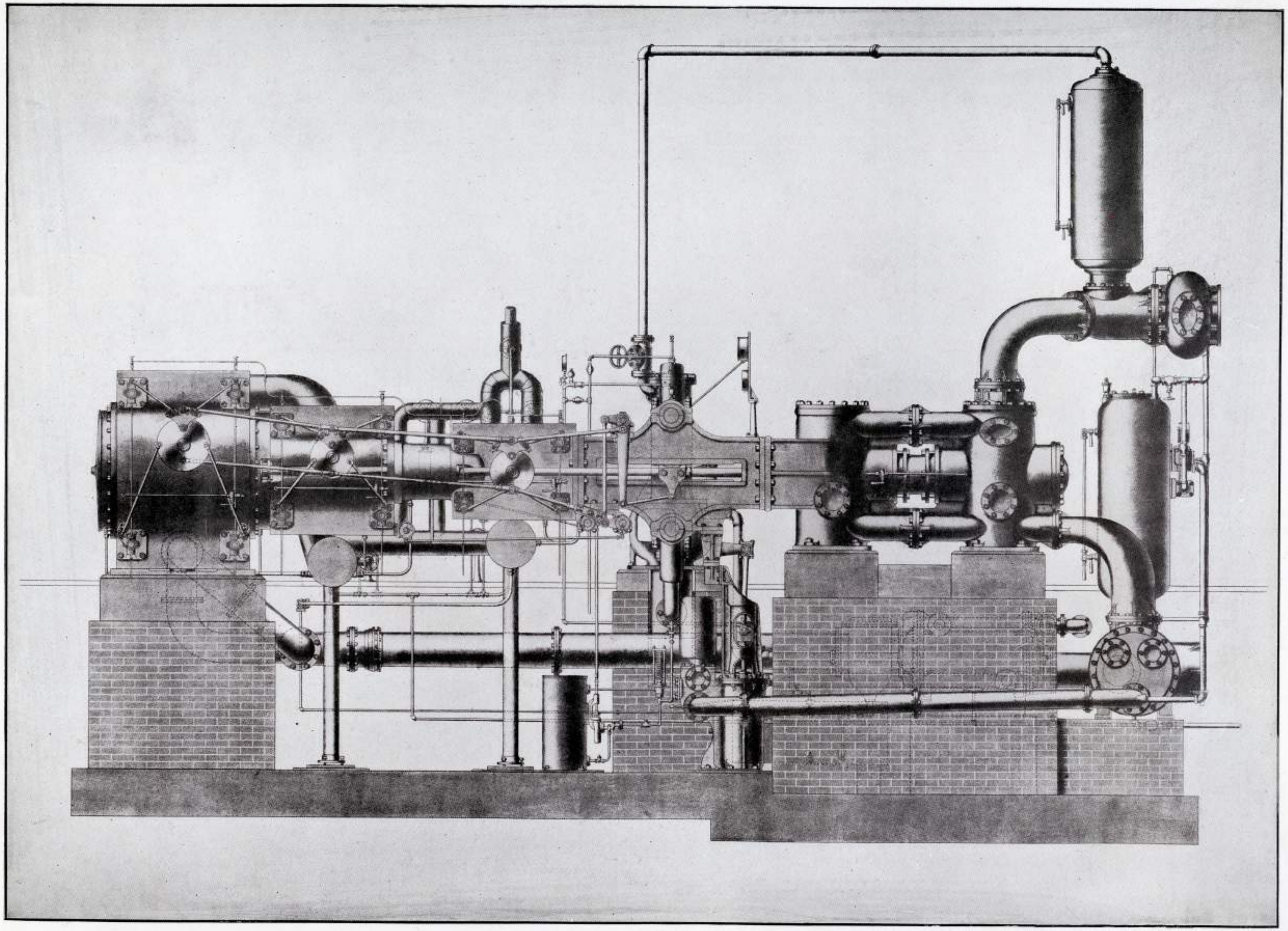
TRADE MARK.



# History OF THE GOLDFIELDS OF COOLGARDIE AND KALGOORLIE WATER SUPPLY SCHEME.

The Contract for the Pumping Machinery including
Twenty High Duty Worthington Engines and
Twenty Babcock & Wilcox Boilers, &c.,
having been carried out by

**Messrs. James Simpson & Co., Ltd.,**
101, Grosvenor Road, S.W.,
and
Newark-on-Trent.



WORTHINGTON HIGH DUTY ENGINE.

# A HISTORY

## Of the Scheme for supplying the Coolgardie Goldfields, Western Australia, with Fresh Water.

IT has occurred to us that a history of the Coolgardie Water Supply Scheme would be of interest to many readers. In this little pamphlet we have told the story of this great work in a manner which will enable the non-professional reader to follow the various steps towards completion with interest, and at the same time the technical matter should be of interest to Engineers generally.

The Coolgardie Goldfields, which is a common name for the great groups of mines at Kalgoorlie and Coolgardie and the immediate neighbourhood, is some 363 miles in a direct line from the Port of Fremantle on the West Coast of Australia. The first 100 miles crosses a series of granite ranges averaging 1,200 feet high, covered with gum trees, &c. The country then becomes a series of broken rolling plains gradually rising towards Coolgardie. The soil, with the exception of a few patches, is sandy and covered with scrub, gum trees, &c. It is to all intents and purposes waterless (the average rainfall being 7·14 inches, and the evaporation 82·6, with a temperature

often over 100 degrees Fahr. in summer), there being in the old days only a few soaks and native wells available for the supply of water.

In the year 1892 the first discovery of gold in payable quantities was made near the site of the present town of Coolgardie. Until the discovery of gold, this desolate and waterless country had been crossed several times by bands of intrepid explorers, the earliest of which was under the leadership of Mr. Forrest, now the Rt. Hon. Sir John Forrest, P.C., G.C.M.G.

When the great rush of 1893 set in, the want of water caused indescribable suffering and loss of life, largely due to typhoid, and as the railway only ran to Southern Cross, some 235 miles from the coast, the remainder of the distance had to be done in stage coaches or any other vehicle that could be made available.

As the gold area increased and the various gold-bearing reefs and formations showed signs of being permanent, the Government did all that was possible to minimise the suffering and loss due to the shortness of water. When it is stated that inferior water, hardly fit for human consumption, was worth 2s. 6d. per gallon, and very scarce at that, some idea of the condition of affairs is conveyed to our readers.

The Government excavated tanks and built dams on the roads to the fields. As the mines developed, at the lower levels salt water was found, which was condensed and sold at 70s. per 1,000 gallons. In this way, some sort of a provision was made, but the water supply was still a danger point in connection with the fields. Typhoid fever raged, and owing to the extreme saltness of the water (there being 30 ozs. of saline matter to the gallon), a quantity of the fine gold was lost.

In 1894 the railway had been extended to the Goldfields, *i.e.*, Coolgardie and Kalgoorlie.

The difficulties and cost of working the traffic were enormously increased, owing to the trouble in obtaining fresh water at almost any price. For example, the cost of water alone to the Railway Department was £1,000 per day during the summer.

Such a state of affairs could not last, as it meant an immense increase in the cost of living on the fields. As gold was being found at other places, such as Menzies, Leonora, &c., the railway would of necessity have to be extended, and water, therefore, was indispensable. Various schemes were propounded, and several offers were made to the Government by groups of capitalists to build and work waterworks to supply the fields if a concession was granted them. An attempt was made to obtain water by boring, but after going down 3,000 feet through granite the attempt was given up.

At the latter end of 1895 Sir John Forrest publicly announced during a visit to Coolgardie that the Government intended to carry out a scheme for the supply of fresh water to the Goldfields by means of pumping from the coast. This was received at the time with a good deal of scepticism.

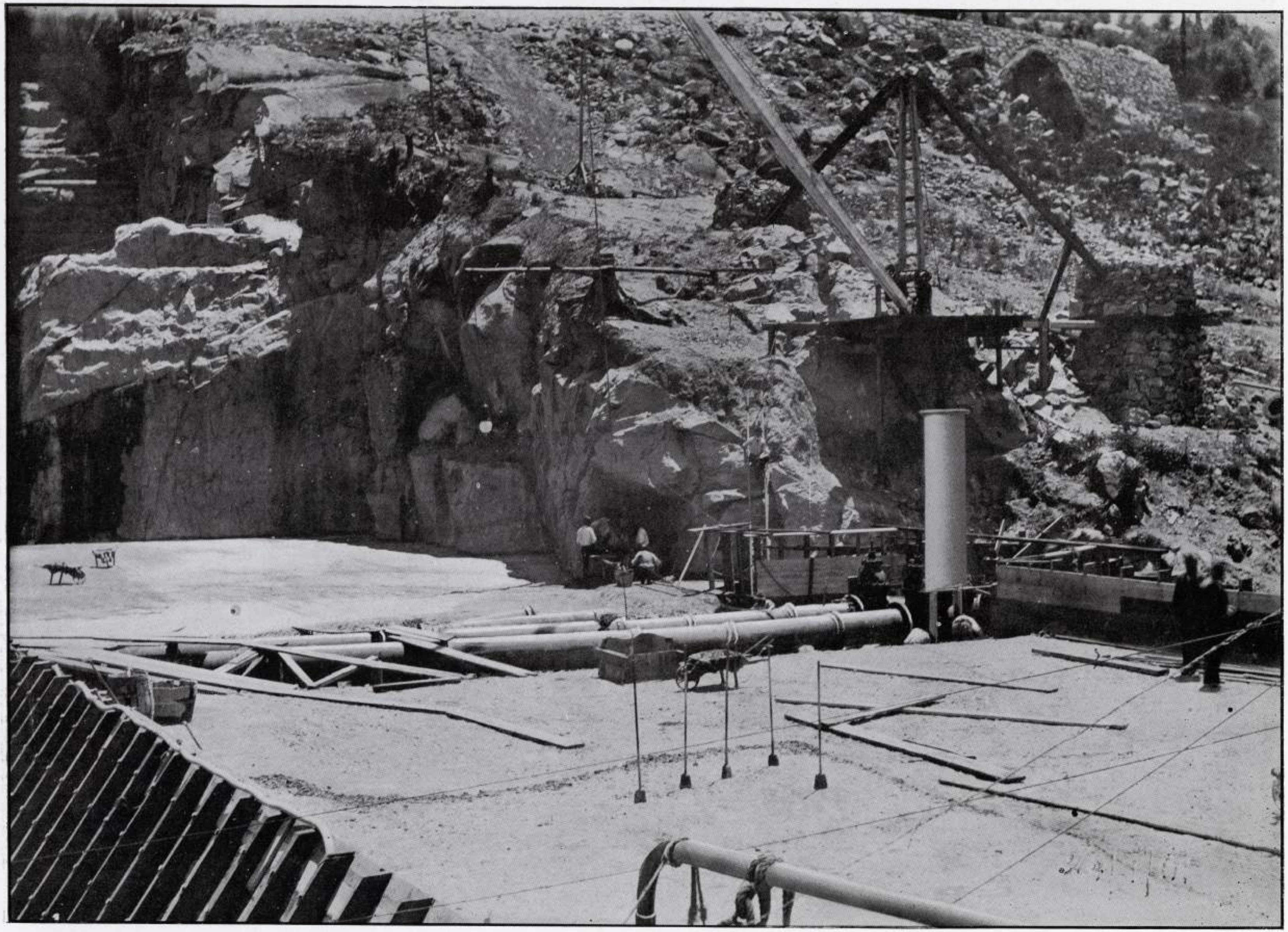
But Sir John Forrest was in earnest. He believed in the future of the Colony and the permanency of the Goldfields, at that time producing 231,513 ozs. of gold per annum.

The late Mr. C. Y. O'Connor, Engineer-in-Chief, was instructed to enquire into the cost and the best method of carrying out a scheme for the supply of water from the coastal or well-watered districts. After months of work and enquiry, in July, 1896, the late Mr. C. Y. O'Connor reported in favour of a scheme which consisted of a reservoir to be built on the Helena River, near

Mundaring in the Darling Ranges, about twenty miles from Perth. The water to be then pumped through a main to Coolgardie. In the first place only 1,000,000 gallons was estimated as the probable requirement; this quantity was, however, increased to 5,600,000 gallons per twenty-four hours, and the estimated cost was set down at £2,500,000 exclusive of the reticulation of the towns *en route*. Sir John Forrest introduced the necessary Bill to the Legislative Assembly in September, 1896, authorising the raising of the money. The Bill met with a storm of opposition, but was ultimately passed.

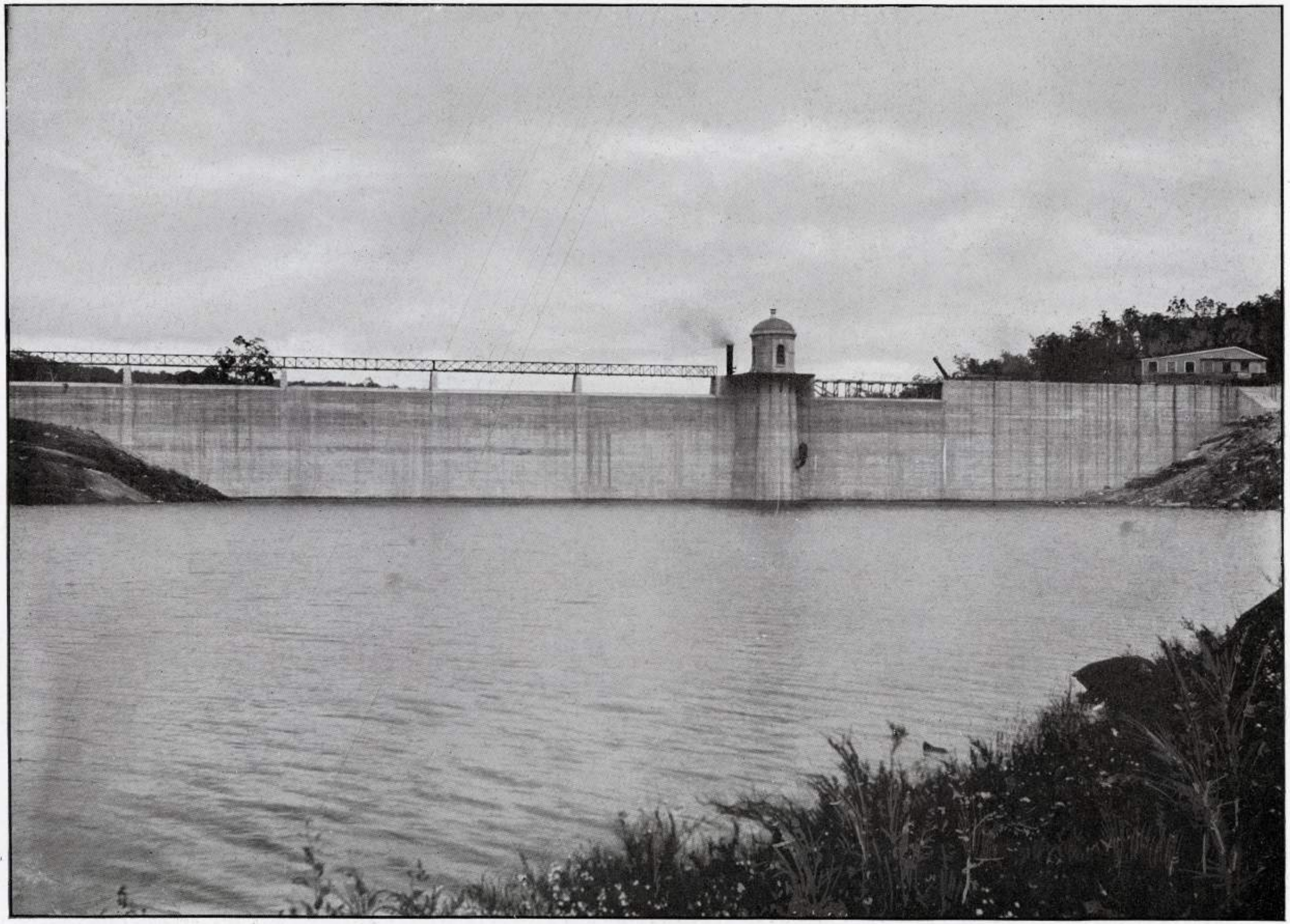
Early in 1897 the late Mr. C. Y. O'Connor left for England with a view to obtaining the highest possible expert opinion on the scheme. A special Commission—consisting of Mr. J. Carruthers, Consulting Engineer to the Colony; Mr. G. F. Deacon, Engineer of the Liverpool Water Supply; and Professor W. Cathorne Unwin, of the City and Guilds Institute—made a most exhaustive enquiry into the possibility of the scheme as proposed by the late Mr. C. Y. O'Connor. The Commission visited all the principal Waterworks and manufacturers of Pumping Machinery in England and on the Continent, and, in addition, Mr. J. Carruthers made an extended trip in America for the same purpose, ultimately reporting in favour of the late Mr. C. Y. O'Connor's proposals. In September, 1898, the Goldfields Construction Bill was passed by the Legislative Assembly.

Before going into the details of the scheme, we propose to give as briefly as possible a sketch of the final proposals and plans on which this great work was carried out. The main supply reservoir is situated in the Darling Ranges, about thirty miles from Perth, 320 ft. above sea level, where two great arms of granite jut out across the narrow valley at the bottom of which flows the Helena River. A gigantic dam of concrete is placed like a huge wedge between these two granite arms, thus closing up one end of the valley, as shown in the illustrations.



SUCTION PIPES AT HELENA WEIR.

DAM IN COURSE OF CONSTRUCTION.



HELENA WEIR (Front View).

HELENA WEIR (Back View).

The dam is constructed of concrete. It is 760 ft. long, and 100 ft. high in the deepest part, and to make assurance doubly sure the foundations were carried down nearly 100 ft. below the level of the river. At the base of the foundations the thickness of the dam varies from 85 to 120 ft., tapering to a width of 15 ft. on the top. 69,000 cubic yards of concrete were used in the construction. The surplus water flows over the crest of the dam. The reservoir or lake thus formed is eight miles long, and contains, when full, 4,600,000,000 gallons of water. The catchment area consists of 850,000 acres, and consists chiefly of granite hills. The water is exceptionally good.

At a trifling cost it would be possible to divert other streams into the reservoir, and so largely increase its capacity. Suitable valve towers are provided to regulate the flow to the first pumping station.

After a series of careful tests and thorough investigation the Government, acting on the late Mr. C. Y. O'Connor's advice, decided to use a new and novel form of pipe. All the best known pipes were passed by, and the decision to use what is known as Mephan-Ferguson's Patent Locking Bar Pipe was arrived at. This pipe consists of two steel plates rolled into semi-circular form, the edges are upset by special machinery and a locking bar forced on. The joint is then finally clamped or closed by means of hydraulic machinery.

The diameter of the Coolgardie pumping mains is 30 in., each pipe being about 28 ft. in length, and made of plates $\frac{1}{4}$ in. thick, and would weigh about $1\frac{1}{4}$ tons. In some sections, where extra pressure existed, the pipes were made of plates $\frac{5}{16}$ in. thick. The total number of pipes required being about 60,000 for the main to Coolgardie, and the total estimated weight of steel plate about 76,000 tons.

Each pipe was subjected to a hydraulic pressure test of 400 lbs. to the square inch, and was then immersed in a bath of hot Trinidad asphalte, and kept there until the steel rose to the same

# Mephan-Ferguson's
## Patent Rivetless or Locking Bar Steel Pipe.

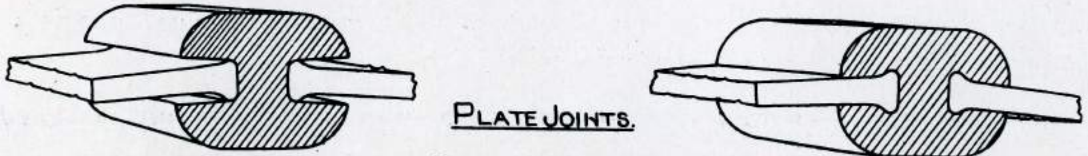
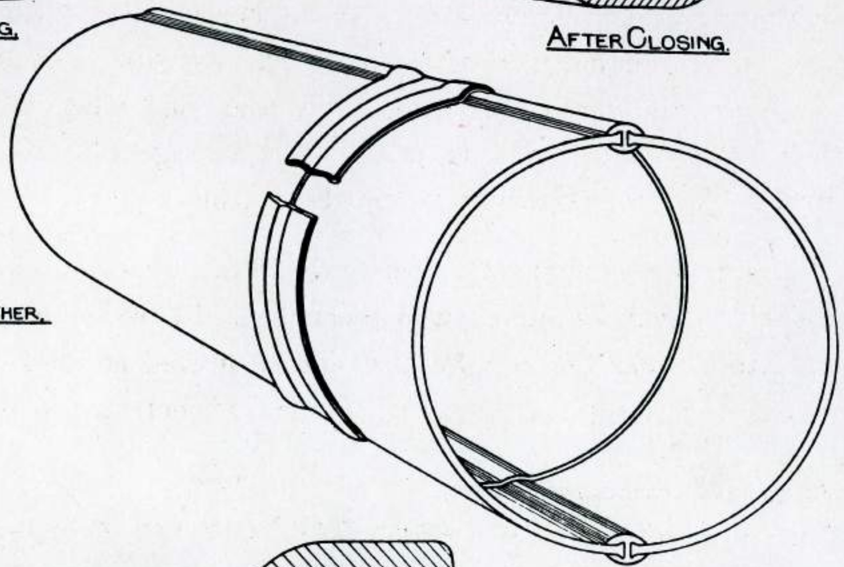
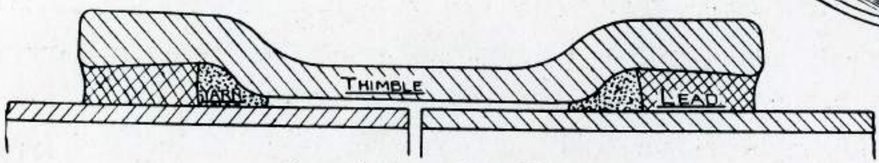


Plate Joints.

Before Closing. After Closing.



Shewing
Two Pipes Jointed Together.




Cross Section of Lead Thimble.

1904
524

James Simpson & Compy Ltd
Engine Works,
Grosvenor Road,
London.

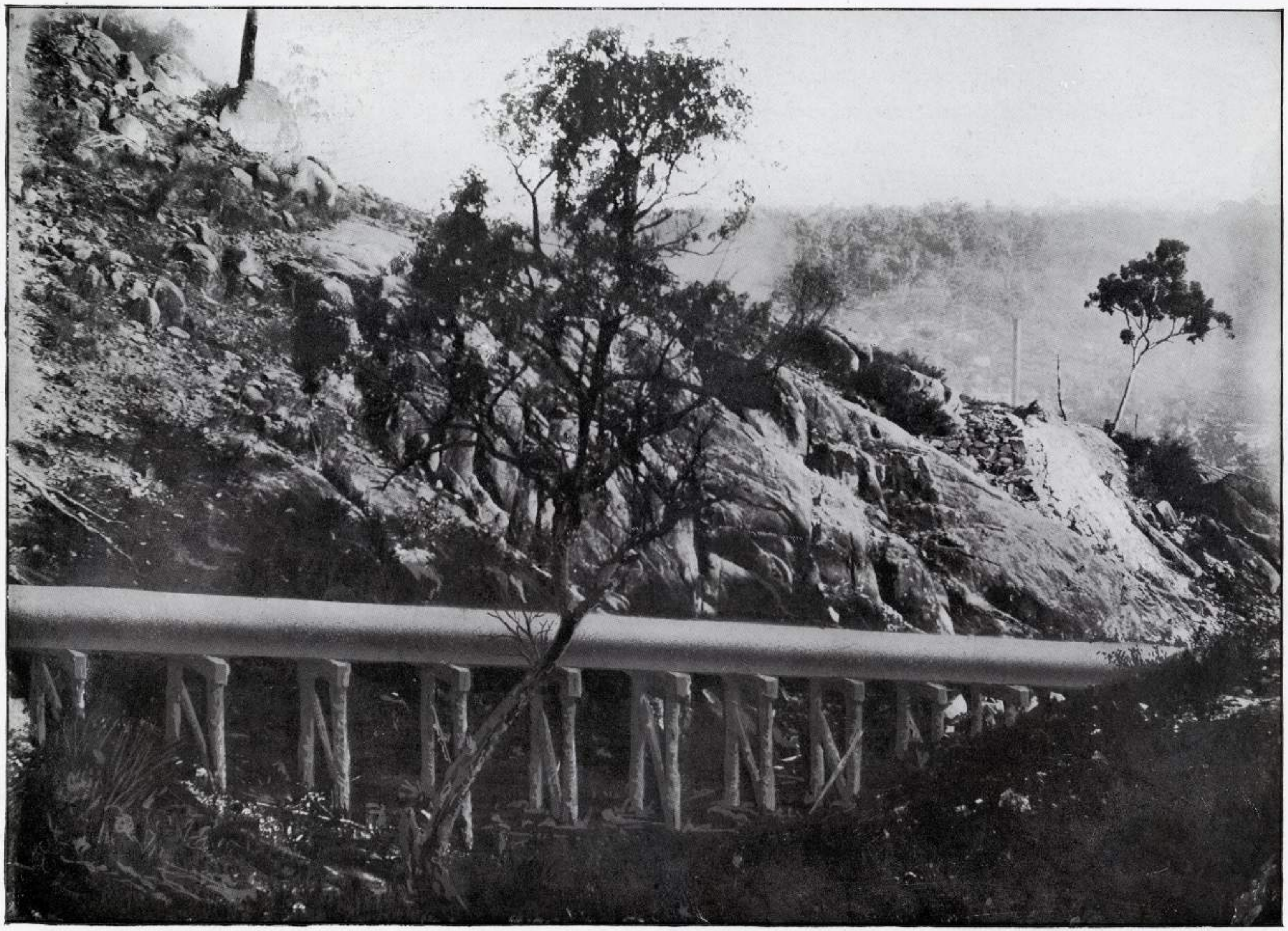
temperature as the bath itself; this coating acts as a preservative against rust, &c. The circumferential joint consisted of a forged steel sleeve with lead caulked joint. The pipe was partly laid in a trench and then covered to a uniform thickness of 2 ft. with soil, except where it ran through salt country, where, in order to avoid corrosion, the pipe was laid on trestles and protected from the sun by suitable covering.

No expansion joints were used or, indeed, found necessary.

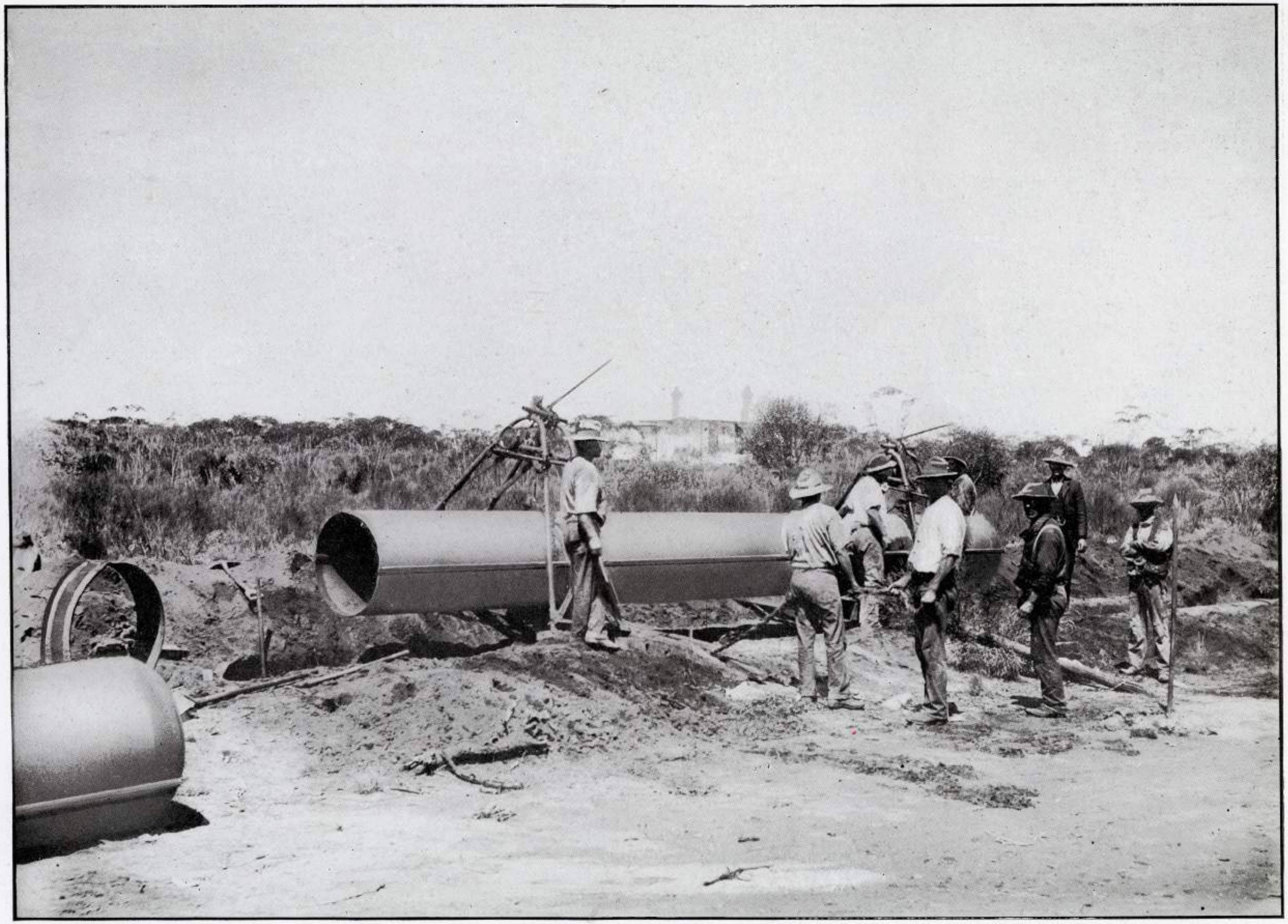
The lead joints of the circumferential steel sleeves were made by a specially designed caulking machine, this machine being driven electrically for a considerable portion of the time, but latterly the electrical drive had to be abandoned owing to the extreme difficulty in getting water for the engine, and the machine was worked by hand. The lead joint where the locking bar comes in was caulked up by means of a small hydraulic press. An average of from twenty to thirty joints per working day of eight hours was accomplished by the machines.

The pipe contracts were signed October 24th, 1898, by two Australian firms—Messrs. Mephan-Ferguson and Messrs. Hosking Brothers—who erected special works at Midland Junction and Falkirk, West Australia. The total contract price for the pipes delivered at works in West Australia amounted to £1,025,000, and the successful carrying out of such a contract in Australia reflects the greatest credit on the two firms mentioned.

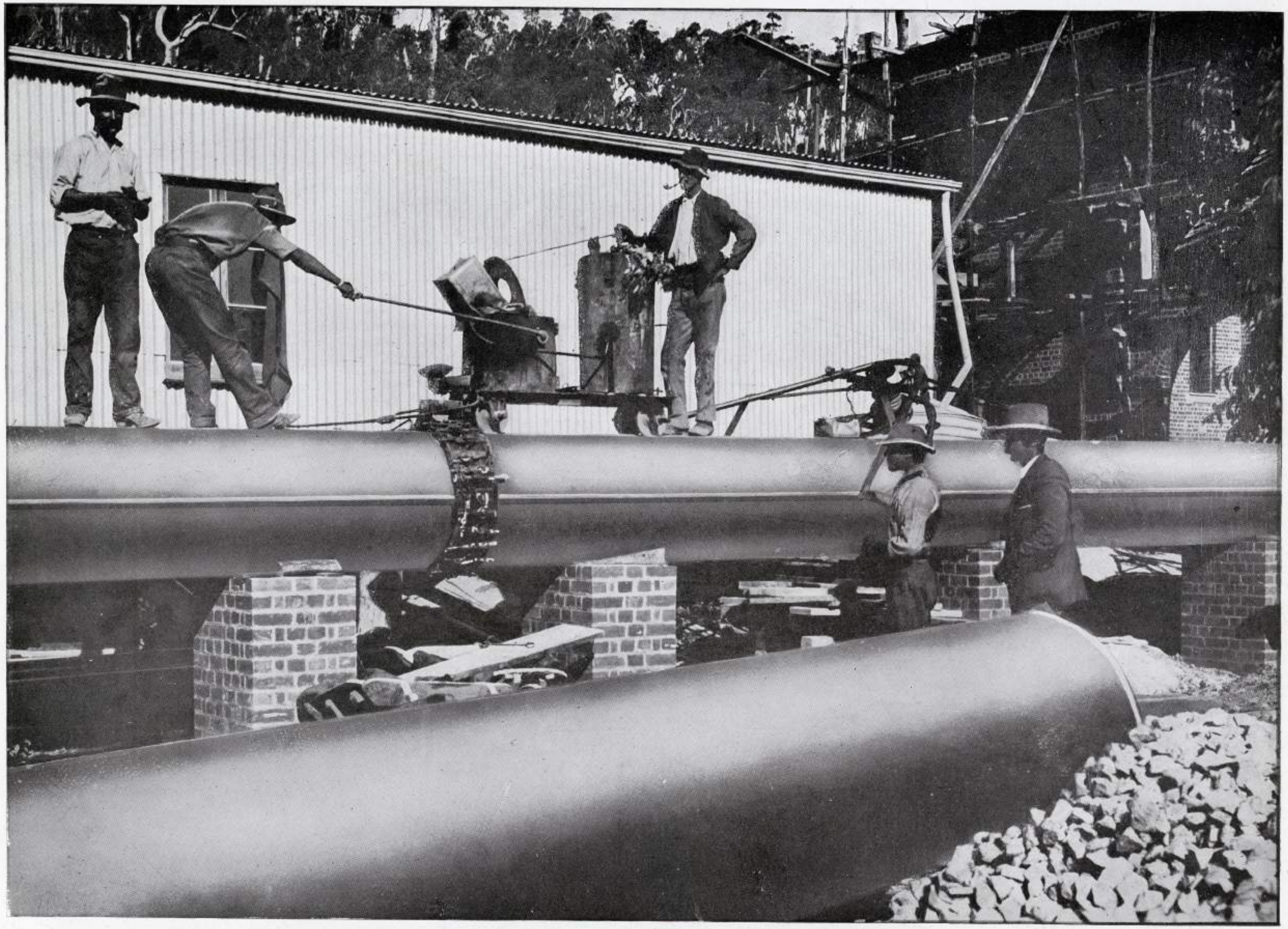
As the Coolgardie Water Supply Scheme had to depend absolutely on mechanical means for the purpose of forcing water through, the question as to what would be the most advantageous type of machine and boiler had to be gone into most carefully. The entire success of the scheme depended on the working of the pumping machinery, and any error in selecting the said type would lead to disastrous financial results.



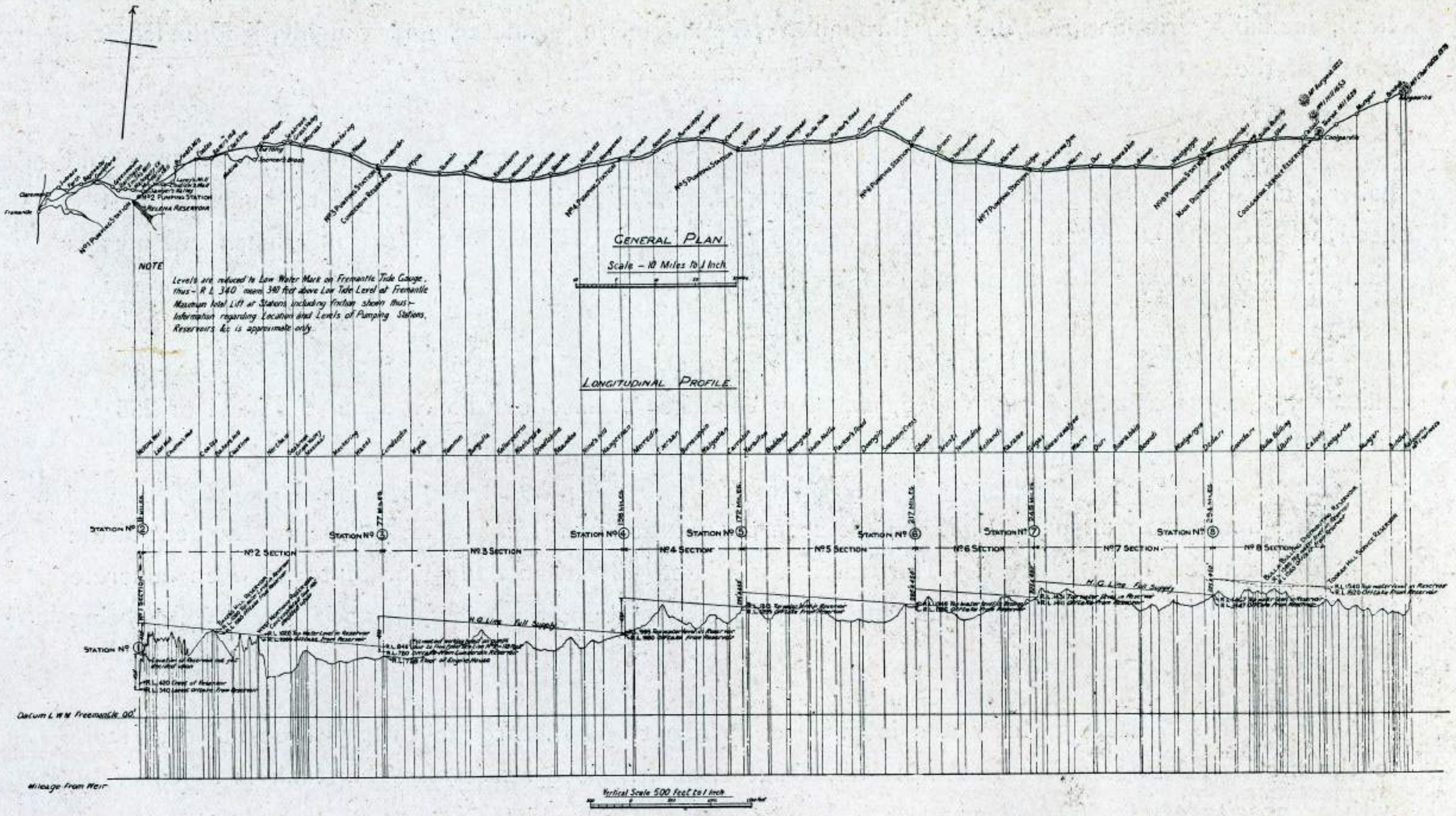
PIPE CROSSING GULLY.



LOWERING PIPE INTO TRENCH.



RUNNING LEAD INTO JOINTS.




— Coolgardie Water Supply. —

— Line of Pipe Track. —

James Simpson & Comp. Ltd.
Engine Works.
Grosvenor Road.
London.

Briefly, the problem was to pump 5,600,000 gallons per twenty-four hours against a total estimated head, including friction of 2,700 ft., through a pipe 30 in. in diameter, and roughly, 330 miles, the speed of the water through the pipe being taken at about 2 ft. per second.

From stations 1 to 4, in each station there are three complete sets of pumping machinery and boilers, any one of which is capable of pumping 2,800,000 gallons per twenty-four hours against a head of 450 ft., so that to get the full quantity of water two sets of engines and pumps are always pumping together into the main, and one set is "spare."

From stations 5 to 8 inclusive, there are at each station two sets of machinery, each set of machinery being capable of pumping 5,600,000 gallons per twenty-four hours against a head of 225 ft., so that while one set is pumping the other set is "spare."

From the map on page 15 it will be seen that station No. 1 is situated close to the foot of the great dam on the Helena River. The water is elevated 421 ft. in daily work into an open concrete tank of a capacity of 468,000 gallons, situated at No. 2 station, the total distance from No. 1 being about $1\frac{1}{2}$ miles.

From No. 2 Station the water is pumped up about 360 ft. through twenty-three miles of main to the first regulating tank at Baker's Hill, about 1,080 ft. above sea-level. This tank is of concrete, with a capacity of 500,000 gallons.

The water runs from Baker's Hill by gravity to a second regulating 500,000 gallon concrete tank at Northam, eighteen miles further on, the Northam tank being 94 ft. lower than Baker's Hill.

Still falling, the water reaches the great tank at Cunderdin, which holds 10,000,000 gallons, and is seventy-eight miles from the Helena reservoir.

Stations 3 to 7 pump the water against a steady rise to the 8th station at Dedari, a distance of 217 miles from Cunderdin, and situated at an elevation of 1,457 ft.

Each station is provided with concrete tanks of 1,000,000 gallons capacity, which act as combined receiving and suction tanks.

From Dedari the water is pumped a distance of twelve miles to the main service reservoir at Bulla Bulling. This reservoir is of concrete reinforced with barbed wire strands, and holds 12,000,000 gallons. Bulla Bulling supplies a small service reservoir of 1,000,000 gallons on Toorak Hill, overlooking the town of Coolgardie, the mean elevation being 1,525 ft.

The total head pumped against in daily working at stations Nos. 1 to 4 varies from 360 ft. to 410 ft., as one or two engines are working. At stations No. 5 to 8 the head is from 180 to 210 ft.

From Toorak tank the water runs by gravity to a reservoir on Mount Charlotte, which is to supply the town of Kalgoorlie. This brief description of the work to be done clearly shows how absolutely the financial success of the scheme depended on the pumping machinery.

In October, 1899, tenders for the machinery were called by the Government. In calling for tenders all the best known and most reputable firms of pumping machinery manufacturers were

invited to tender. It can be safely stated that the whole world was in competition, as the invitations to tender were not confined to any one country.

The late Mr. C. Y. O'Connor very wisely decided that it was useless for him to attempt to say which design should be used, he simply specified what the work to be done consisted of, laid down stringent tests of materials and workmanship, and left to the various firms of manufacturers the onus of submitting plans and proposals as to how they would tackle this proposition.

After months of careful enquiry on the tenders submitted, the Government, acting on the advice of its engineering experts in London and Australia, decided to accept the tender of Messrs. James Simpson & Co., Limited, of London, a special clause being inserted in the contract giving them permission to have half of the manufacturing done by the Worthington Company.

Their tender was by no means the lowest, but the proposals made by this firm were of so complete a nature, and the design of engine offered—viz., the Horizontal High Duty Duplex Direct Acting Worthington Engine—was guaranteed to give such highly economical results in working, that the Government decided to pay the higher price asked for them, especially as it was well known that the Worthington Company and Messrs. James Simpson & Co., Limited, had the greatest experience in the world of waterworks and pipe line machinery. The Government could not, and dare not, risk a failure, and they, therefore, wisely decided to give the work to two firms who held such a magnificent record, both for the character of their work and for their enormous experience in the carrying out of pumping installations of the largest capacity throughout the world.

Under this contract Messrs. James Simpson & Co., Limited, agreed to completely erect and have in full working order the whole of the pumping machinery, boilers, accessories, &c., within twenty-seven months of the signing of the contract.

The size and type of engine selected was as follows, for stations Nos. 1 to 4 inclusive:—

Twelve Triple Expansion High Duty Worthington Pumping Engines,

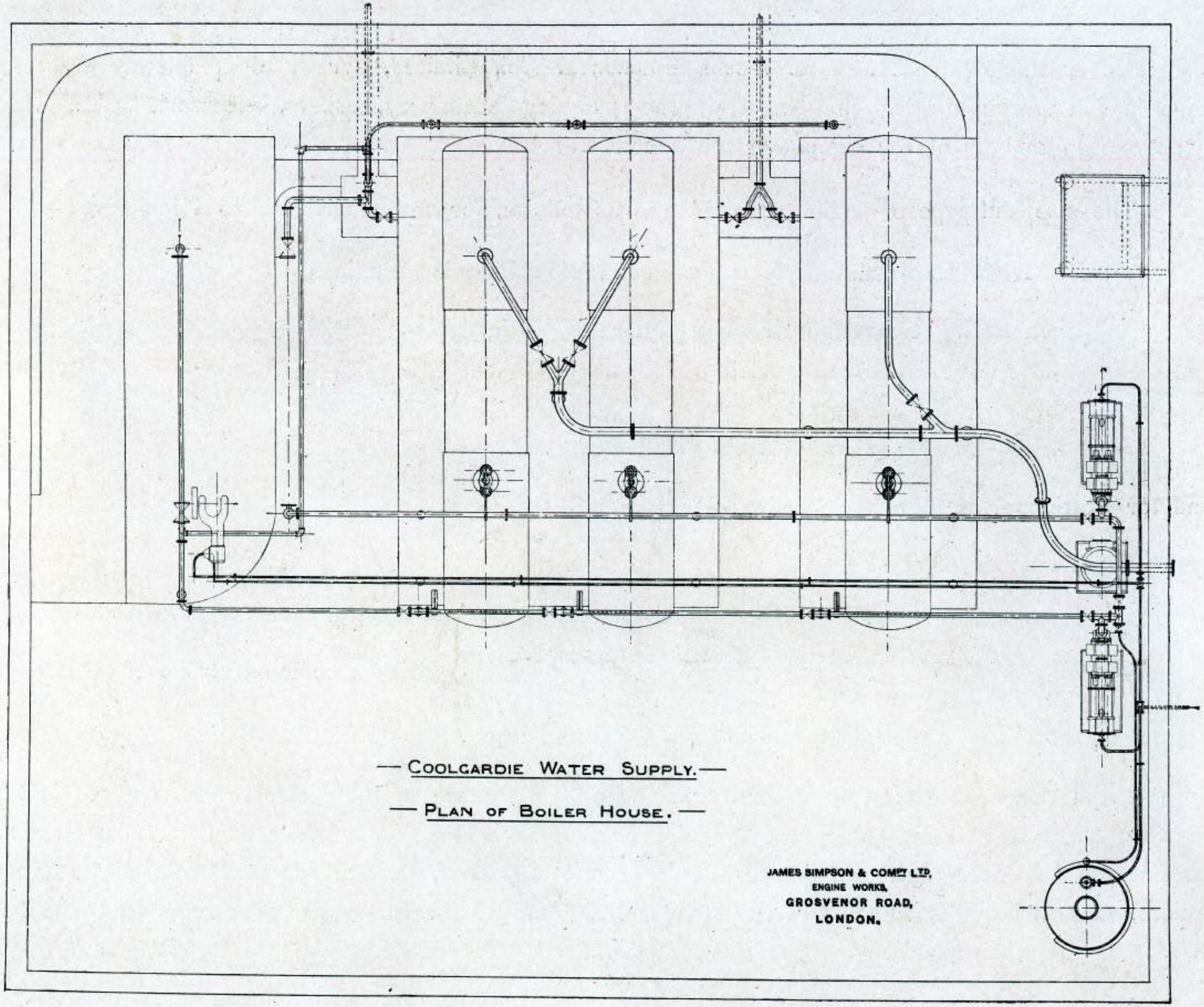
| | | | | | | |
|---|---|---|---|---|---|---|
| Each having two | High Pressure | Cylinders, | 16 in. | All of a common stroke of 36 in. |
| ,, ,, ,, | Intermediate ,, | ,, | 25 ,, | |
| ,, ,, ,, | Low Pressure | ,, | 46 ,, | |
| ,, ,, ,, | Double Acting | Plungers, | 15 ,, | |

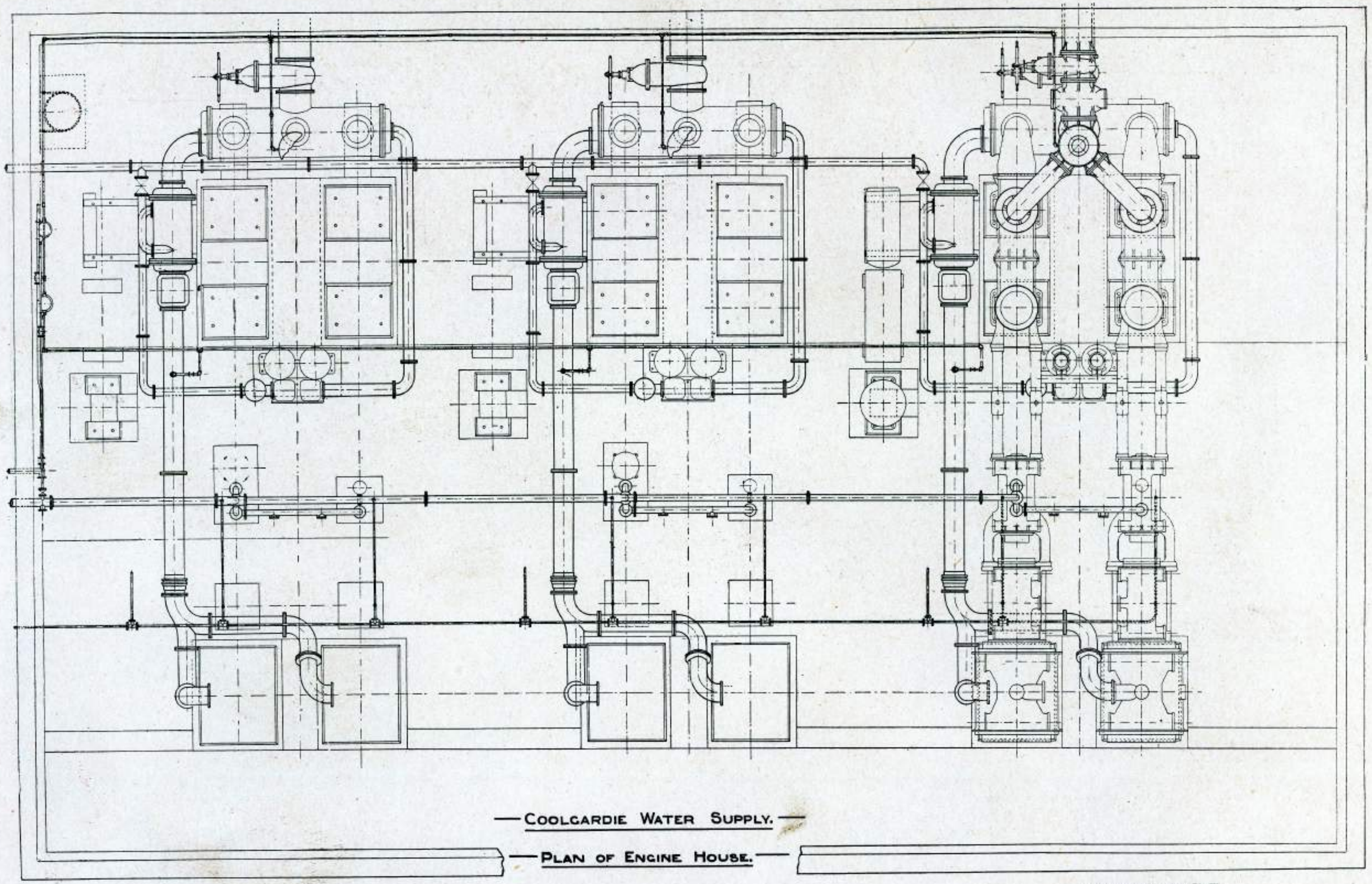
and for Stations Nos. 5 to 8 inclusive:—

Eight engines of similar type,

| | | | | |
|---|---|---|---|---|
| Each having two | High Pressure | Cylinders, | 16 in. | All of a common stroke of 36 in. |
| ,, ,, ,, | Intermediate ,, | ,, | 25 ,, | |
| ,, ,, ,, | Low Pressure | ,, | 46 ,, | |
| ,, ,, ,, | Double Acting | Plungers, | 21 ,, | |

From these sizes it will be seen that the only difference in the whole of the engines is that eight of them had 21 in. water plungers and twelve had 15 in. The whole of the steam ends are standard to one size. The gain in economy is at once apparent, as it means the whole of the twenty boilers, accessories, &c., could be made standard, and the number of spare parts required to be held in store is greatly reduced.


— Coolgardie Water Supply. —
— Plan of Boiler House. —
James Simpson & Comy Ltd,
Engine Works,
Grosvenor Road,
London.



—Coolgardie Water Supply.—

—Plan of Engine House.—

James Simpson & Comy Ltd,
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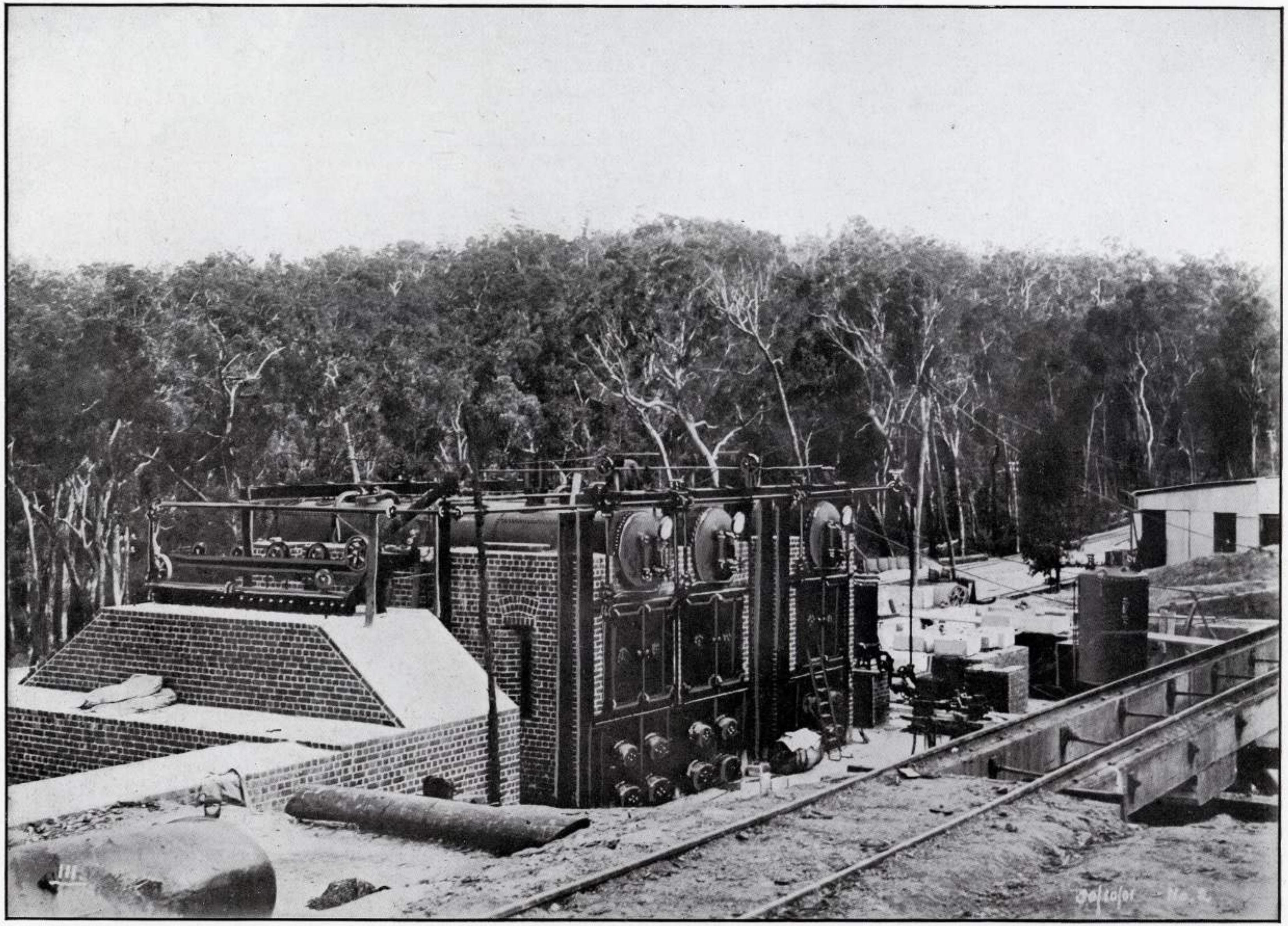
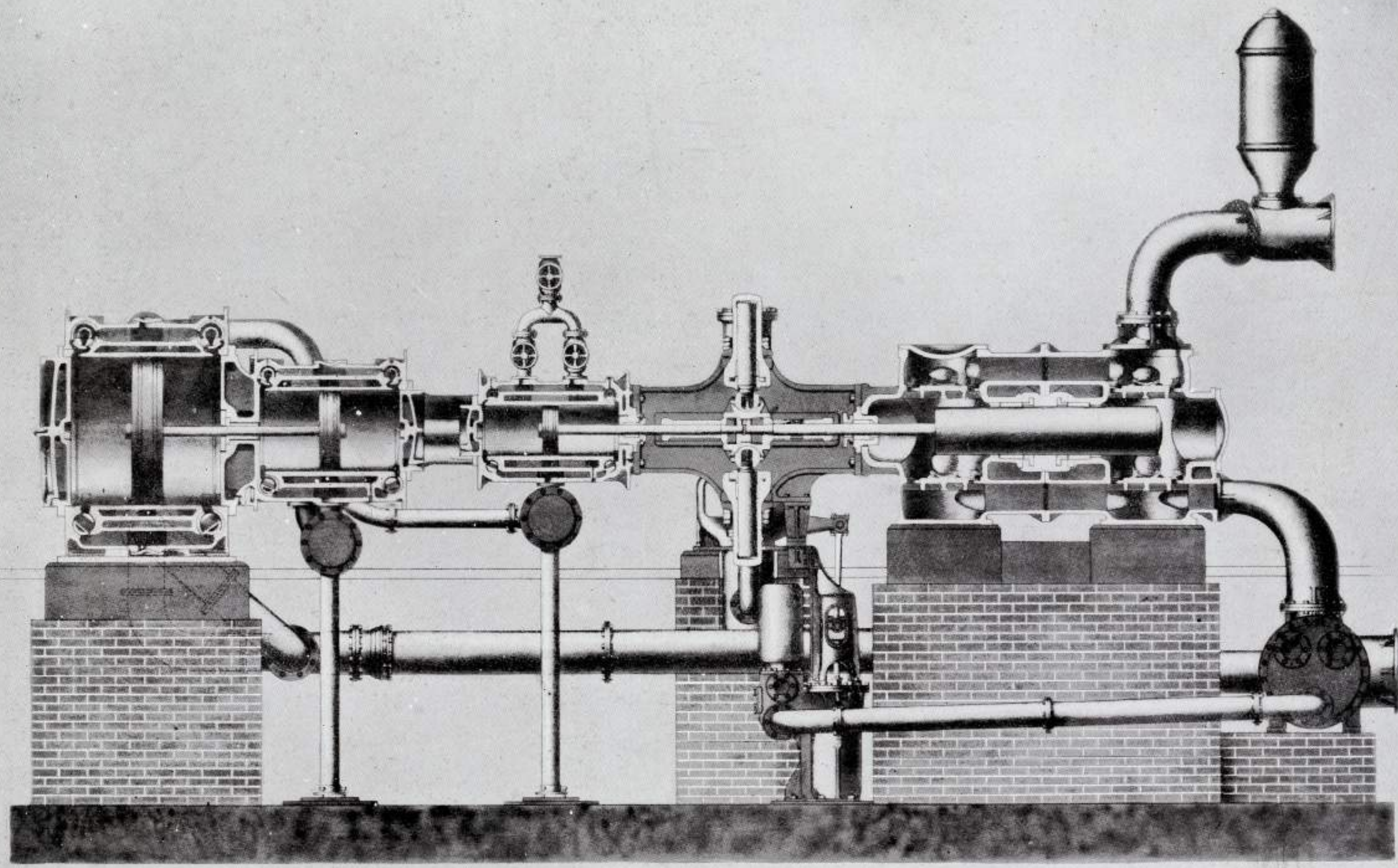


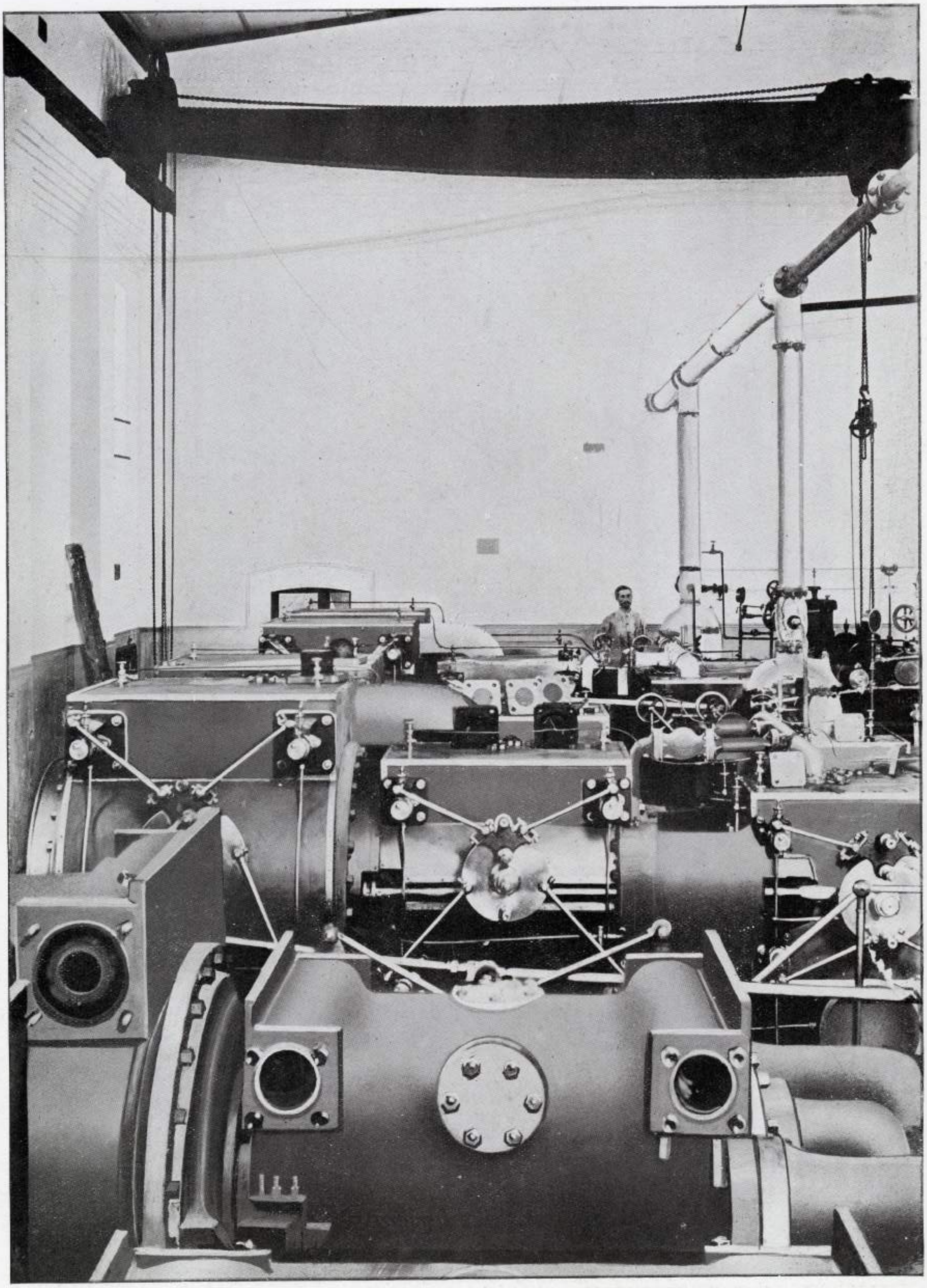
BABCOCK & WILCOX BOILERS.


BABCOCK & WILCOX BOILERS AND ENGINE FOUNDATIONS.

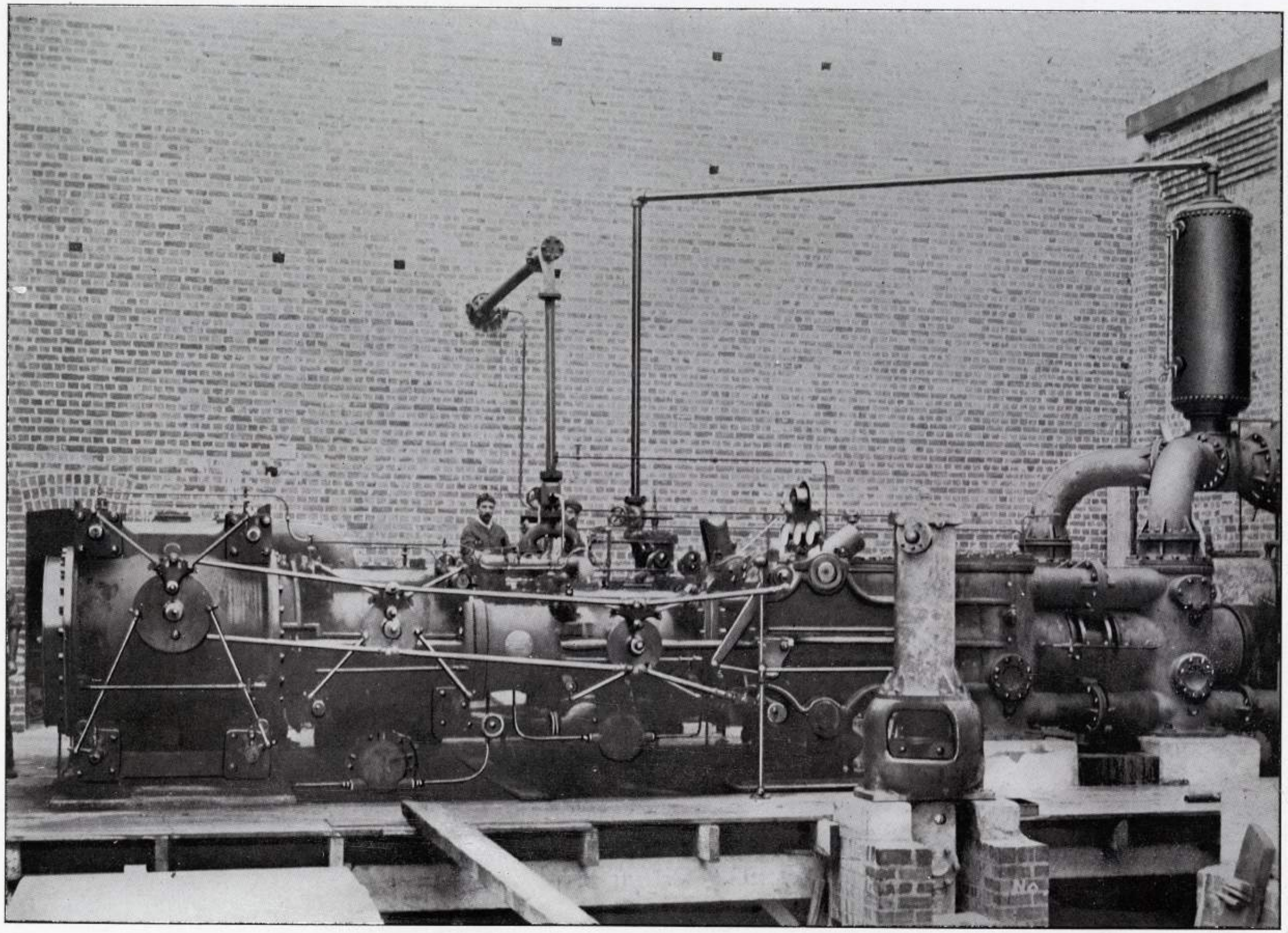


Coolgardie Water Supply.

Sectional Elevation of Engines.



VIEW LOOKING ON TO CYLINDERS IN COURSE OF ERECTION.



ENGINE IN COURSE OF ERECTION, SHOWING WATER END.

The boilers are Babcock & Wilcox, with single drums, and are equipped with superheaters, and to secure the highest possible economy, Webster Feed Water Heaters and Green's Economisers, with all necessary accessories, are provided in the boiler house; one boiler for each engine being provided.

The following particulars of the engines should be of interest:—

The steam ends of each engine consist of—

Two 16 in. High Pressure Cylinders,
„ 25 in. Intermediate Pressure Cylinders,
„ 46 in. Low Pressure Cylinders.

The whole of these are jacketed with steam at boiler pressure, viz., 175 lbs. per square inch, the cylinder covers being jacketed as well. The estimated I.H.P. of each Duplex engine may be taken at 300 H.P. The jackets are cast on the cylinders.

The general arrangement of the rods is in accordance with the Worthington patents. The rods themselves being of the Vickers-Maxim oil-toughened steel turned and then ground to size.

The steam valves are rotative, of the Corliss type, and are driven by the Worthington Patent High Duty Valve Gear.

Intermediate reheaters with steam at boiler pressure are used between the high pressure cylinders and intermediate pressure cylinders, and the intermediate pressure cylinders and the low pressure cylinders.

The air pumps are placed immediately below and between the steam and water ends of the engine, and are driven by means of links and levers from the crossheads.

The water ends are of the Worthington outside packed plunger type, fitted with steel air vessel on the delivery and cast-iron air vessel on the suction. The suction and delivery valves of the water ends are of the Worthington type with gun-metal seats, and the valves themselves are stamped out of the best Manganese bronze.

The condenser is placed on the suction, so that the whole of the water of the main passes through the condenser, and, as the volume is largely in excess of what is actually required, the temperature of the water in the main is not raised to any appreciable extent.

It is well known that the efficiency of the Worthington High Duty Engine is attained by the high duty attachment with which it is provided; this also forms an ample safeguard in the event of the delivery main bursting at any time. These engines have also been fitted with an automatic vacuum breaking apparatus, so arranged that when the pressure in the main falls below or rises above a prearranged limit, it immediately comes into action and opens a valve on the exhaust pipe to the atmosphere, and the engine stops immediately.

The main pumps of each engine consists of two sets of double acting plungers, working on the well-known "Worthington Cycle," which means one set of pumps is always delivering into the main, with the result that the delivery is most uniform and shocks are entirely avoided, which makes this class of engine the most suitable for pumping through long lengths of main.

The marvellously even flow of water in the mains astonished everyone, as some of the local experts had prophesied a blow of sixty tons to the square inch at every revolution. Needless to say they are now completely discredited.

The exhaust steam, on leaving the low-pressure cylinder, passes through a Webster Oil Separator and hence to an auxiliary feed water heater of the tubular type, then through the condenser and air pumps to the feed water tank.

An ingenious arrangement for using the jacket steam has been carried out. As the steam passes from the jackets it is taken and used to drive the feed pumps, which are of the usual Worthington boiler pressure type. These feed pumps exhaust into the "Webster" Feed Water Heater. By these means the feed water is sent forward from the "Webster" Feed Water Heater to the "Green's" Economiser at a very high temperature.

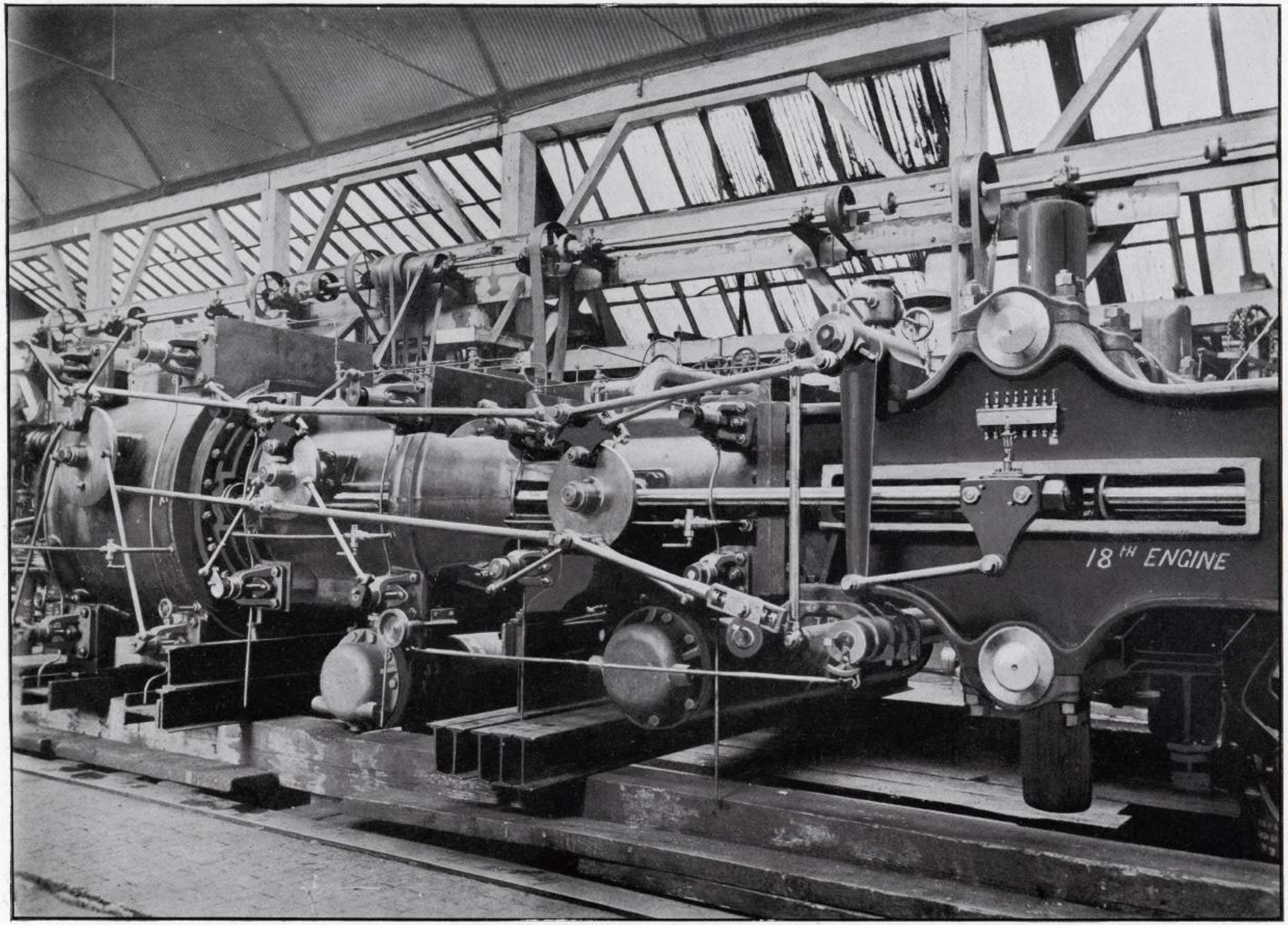
Perhaps the most important portion of the machinery which conduces to the high working economy obtained is the well-known Worthington high duty attachment, by means of which the excess of power exerted by the steam in the cylinders at the beginning of the stroke is stored up and transmitted to the end of the stroke when the steam pressure, owing to expansion, is smallest.

Owing to the high temperature of the steam used, viz., 500 degrees Fahrenheit approximate, the whole of the piston rods and valve spindles have been fitted with metallic packing.

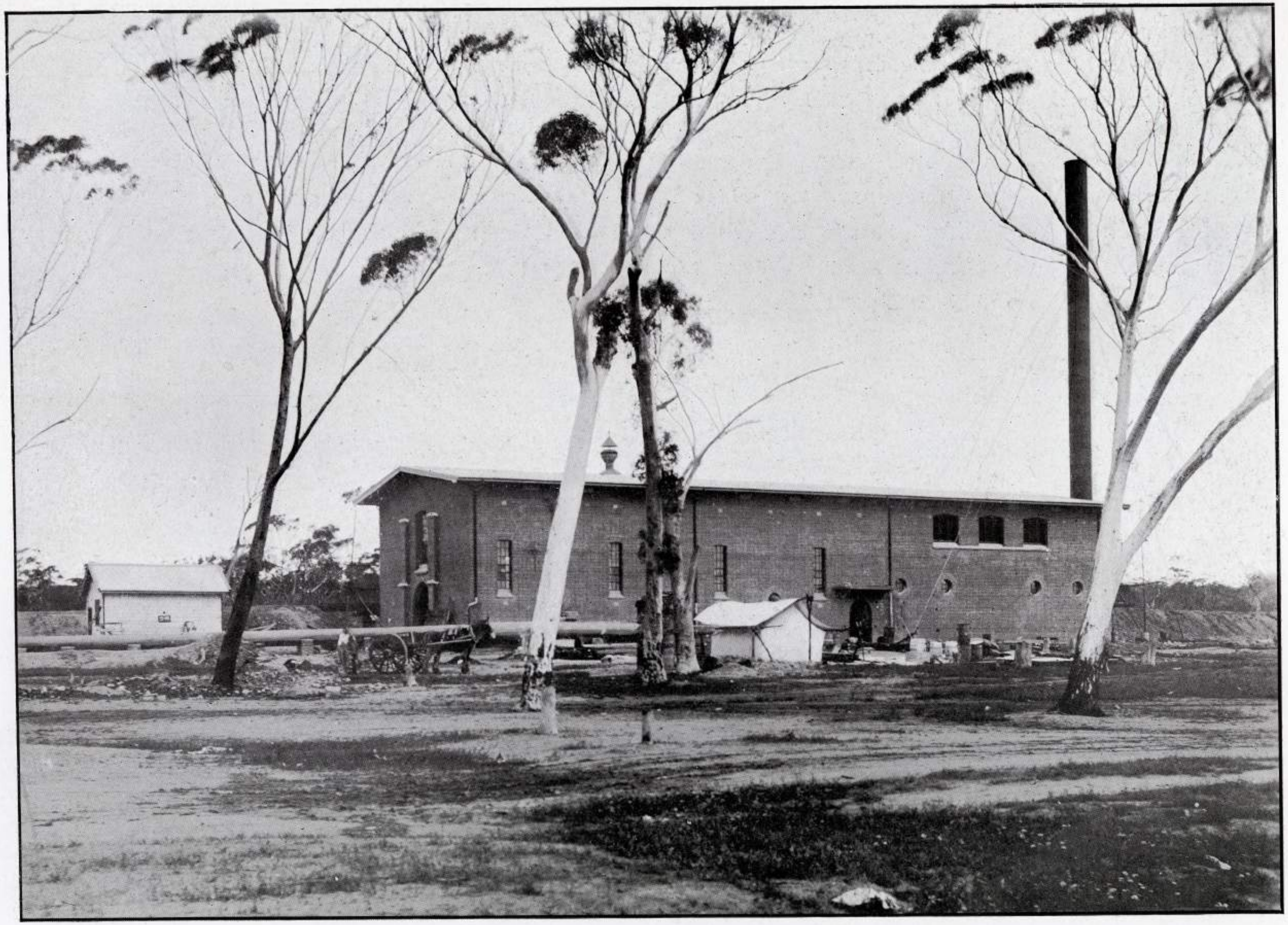
The engine and boiler houses are of brick, and present a very fine appearance. Suitable overhead travelling cranes are provided, which can be operated from the floor of the engine house.

The cylinders, steam piping, and all parts liable to radiate heat are well covered with "magnesia" insulating material.

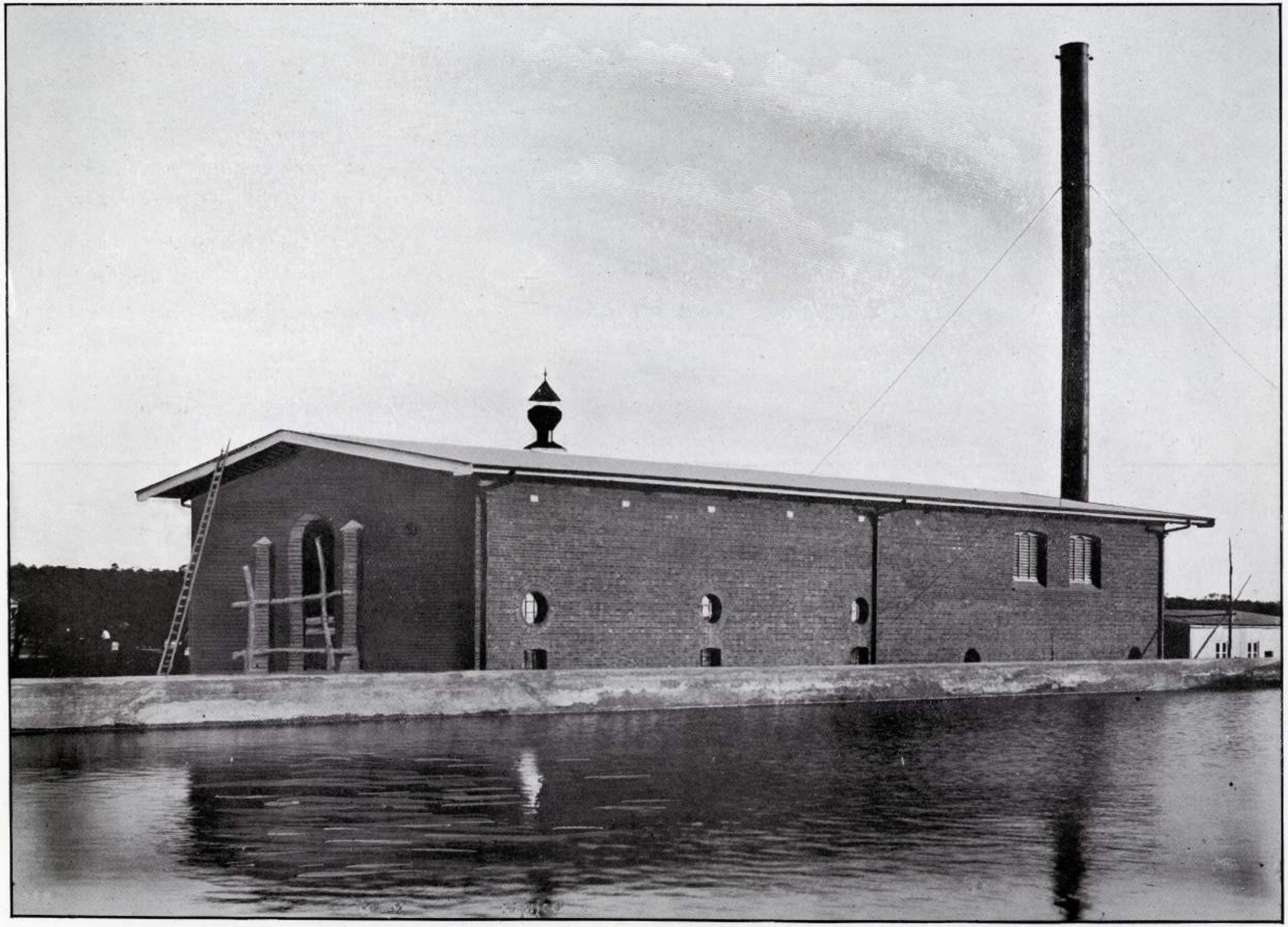
The contract with the West Australian Government provided that each of the pumping engines should be capable of attaining throughout a twelve hour trial a duty of 135,000,000 foot pounds of




ENGINE IN COURSE OF ERECTION IN WORKS, SHOWING HIGH DUTY ATTACHMENT.



ENGINE AND BOILER HOUSE AT No. 3 PUMPING STATION.



ENGINE AND BOILER HOUSE AND TANK AT No. 5 PUMPING STATION.

effective work per 1,000,000 British thermal units supplied to the engine, which would not be returned to the boiler in the ordinary course of working. It also provided that, for the purpose of testing the combined working duty of the pumping engines and boilers, two groups of machinery at one of the first four stations and one group of machinery at one of the second four stations should be capable of pumping through the main to the next reservoir not less than 2,800,000 imperial gallons of water during a twelve hour trial; and that the combined duty of the group should throughout such trial amount to at least 135,000,000 foot pounds of effective work for every 160 lbs. of coal consumed, such coal being equal to a fair sample of good Collie (W.A.) coal, having a calorific value of 10,000 British Thermal Units per pound.

The Government engineer for the Coolgardie Water Supply selected a group of machinery at the No. 2 pumping station, and at the No. 8 pumping station for the purposes of running the official trials.

At the No. 2 pumping station the trial resulted in a duty of 142,093,598 foot pounds of work being obtained per 1,000,000 British Thermal Units, showing a margin of 7,093,598 foot pounds of work in favour of the engines. The working duty trial resulted in a duty of 144,427,000 foot pounds of work being obtained for each 160 lbs. of coal consumed, showing a margin of 9,427,000 foot pounds in favour of the engines. The amount of water pumped during the twelve hours by the two groups of machinery was 2,998,081 gallons, being an excess of 198,081 gallons.

At the No. 8 pumping station the trial resulted in a duty of 142,934,958 foot pounds of work being obtained per 1,000,000 British Thermal Units, showing a margin of 7,934,958 foot pounds of work in favour of the engines. The working duty trial resulted in a duty of 148,141,000 foot pounds of work being obtained for each 160 lbs. of coal consumed, showing a margin of 13,141,000 foot pounds

COAL SIDING IN COURSE OF CONSTRUCTION.

in favour of the engines. The quantity of water pumped by the engines during the twelve hours was 3,147,559 gallons, showing an excess of 347,559 gallons.

The fuel to be used is a local coal obtained from the Collie Coal Fields of Western Australia. It is estimated that some 30,000 tons of coal per annum will be required when the plant is running full time, *i.e.*, the full twenty-four hours.

The Government have therefore put in railway sidings at each pumping station, and have erected coal bunkers under cover capable of holding some 200 tons each.

The trucks of coal are run on to an elevated timber gantry and the coal then unloaded.

We have described the plant as it is now, erected and in full working order. But the greatest problem was to get the plant, which weighs some 3,500 tons, out to the Colony, and when there to get each piece of machinery sorted and sent on to its proper station and erected.

As our readers are aware there are twenty groups, each consisting of an engine and boiler, distributed over 330 miles of country. It will be readily seen that if mistakes were made in consigning the machinery it would be very costly to rectify them. An ingenious system of shipping was adopted which worked perfectly. Each group was given a distinctive colour and letter, and every part of the group was painted with the distinctive group colour to which it belonged.

When the parts were cased one end of the packing case was also painted with the correct group colour. In addition, each case or package was numbered consecutively and marked with the

group letter. All marks were in duplicate, one set being painted on the case or package, and the other stamped on sheet tin tabs which were fastened on to the cases or packages.

No parts of different groups were allowed to be packed in the same case.

By these simple precautions all trouble was avoided. The railway, shipping and wharf men were supplied with coloured group key plans, and so were able to pick out at once the various cases and packages belonging to each group and to send them on to their correct destination. This will be appreciated when we state there were some 5,000 packages, and the only complaint received from the erection staff as to missing material referred to one $\frac{1}{2}$ in. hydraulic valve.

In most countries where waterworks or other engines are to be erected the site of the engine house, &c., is situated within reasonable distance of some town or available place, where men could find lodging and food, and where supplies, stores, &c., could be obtained. On the Coolgardie contract this was not possible. Most of the engine sites are miles away from any source of supply, not only of food, but of what is in a dry country even more necessary, water.

The time given for the completion of the work, viz., twenty-seven calendar months, was exceedingly short, bearing in mind its magnitude. It was, therefore, necessary to arrange for the engine and boiler erection to be carried on simultaneously at the eight stations.

The arrangements made were as follows:—Sufficient land was leased from the Government by the contractors, James Simpson & Co., Limited. This plot of land was enclosed and on it was erected the permanent camps, workshops and mess-rooms.

SITE OF No. 1 PUMPING STATION.

CAMP AT No. 4 PUMPING STATION.

The object in having the land formally leased was to enable the contractors to insist that everyone who came within the enclosure and enjoyed the use of the camp should conform to the regulations laid down for the running of the same. The most stringent regulations as to sanitation were rigidly enforced, with the result that no serious case of illness in any of the camps occurred. In addition to the camps for the men to live in, small workshops were erected both for the storage of tools, gear, machinery, and the carrying out of small repairs.

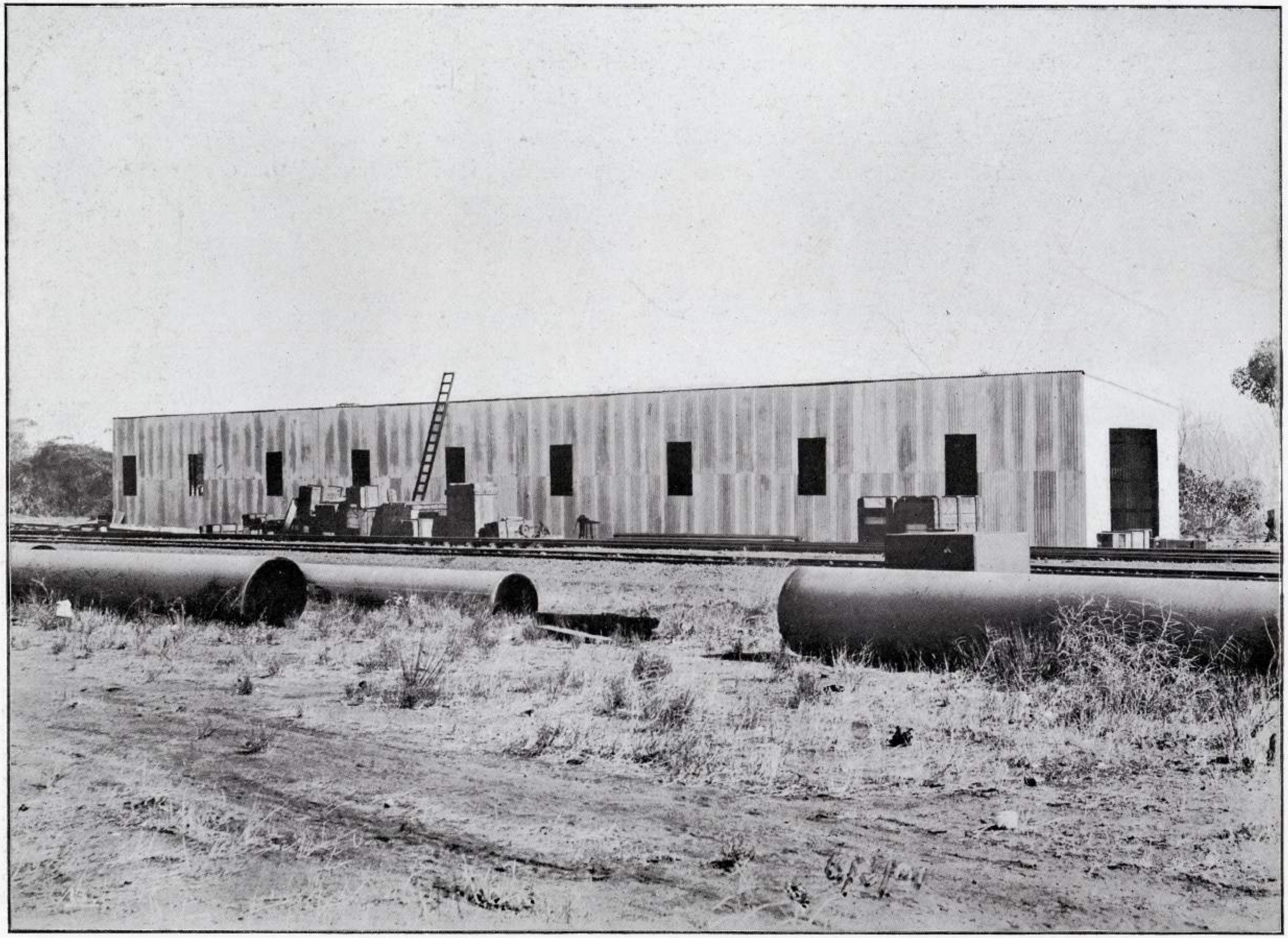
At No. 3 station the general workshop and store was erected.

The plant was driven by a suitable engine and boiler, and the largest lathe could handle the outside piston rods, some 17 ft. long, or turn up a low pressure piston.

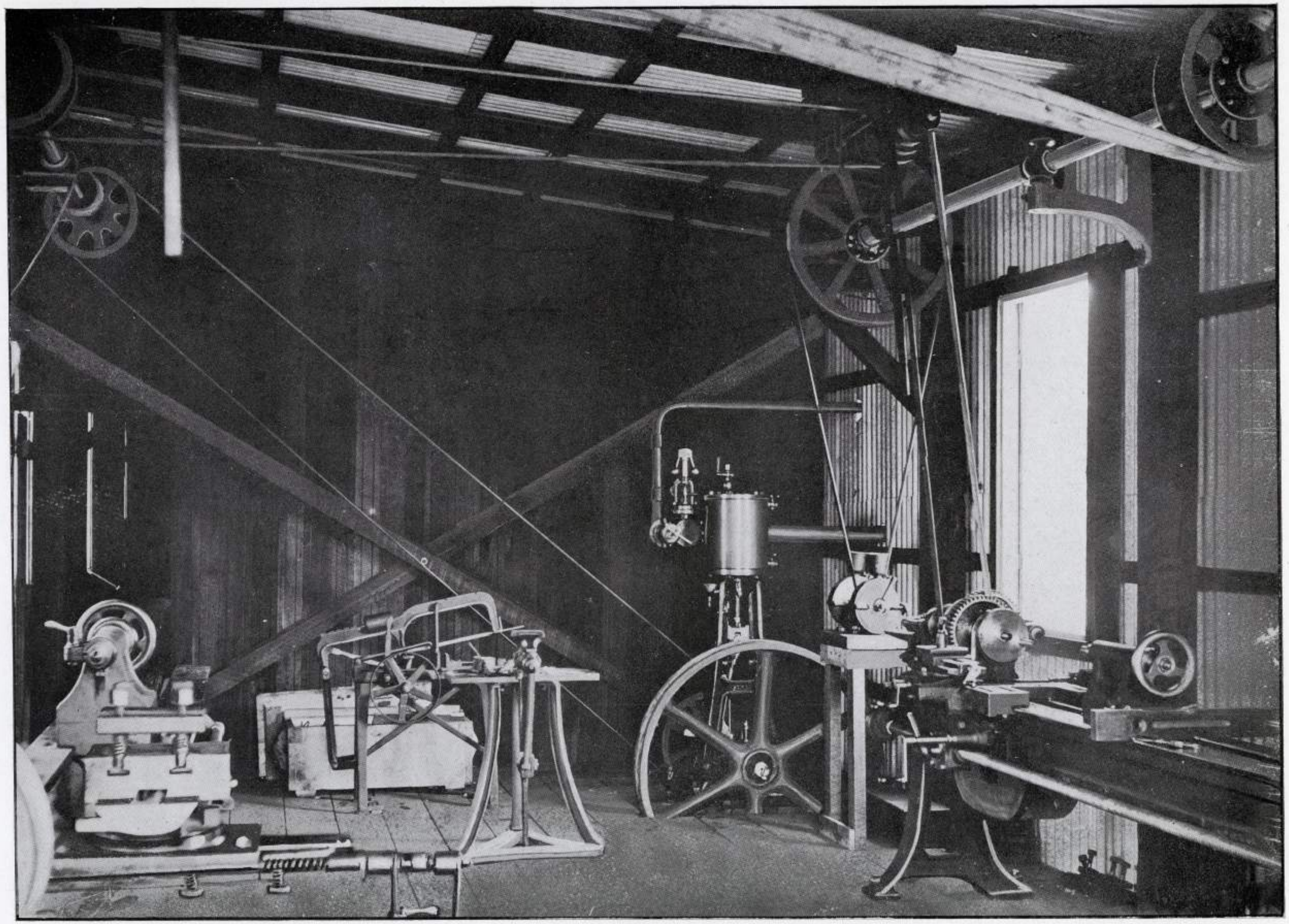
In a country where labour is dear it paid to have the best and most perfect mechanical appliances that could be bought. The plant was erected with the greatest care, and has given results of the utmost value on the work.

Such, in a very abbreviated form, is the history of the greatest pumping scheme that has ever been carried out.

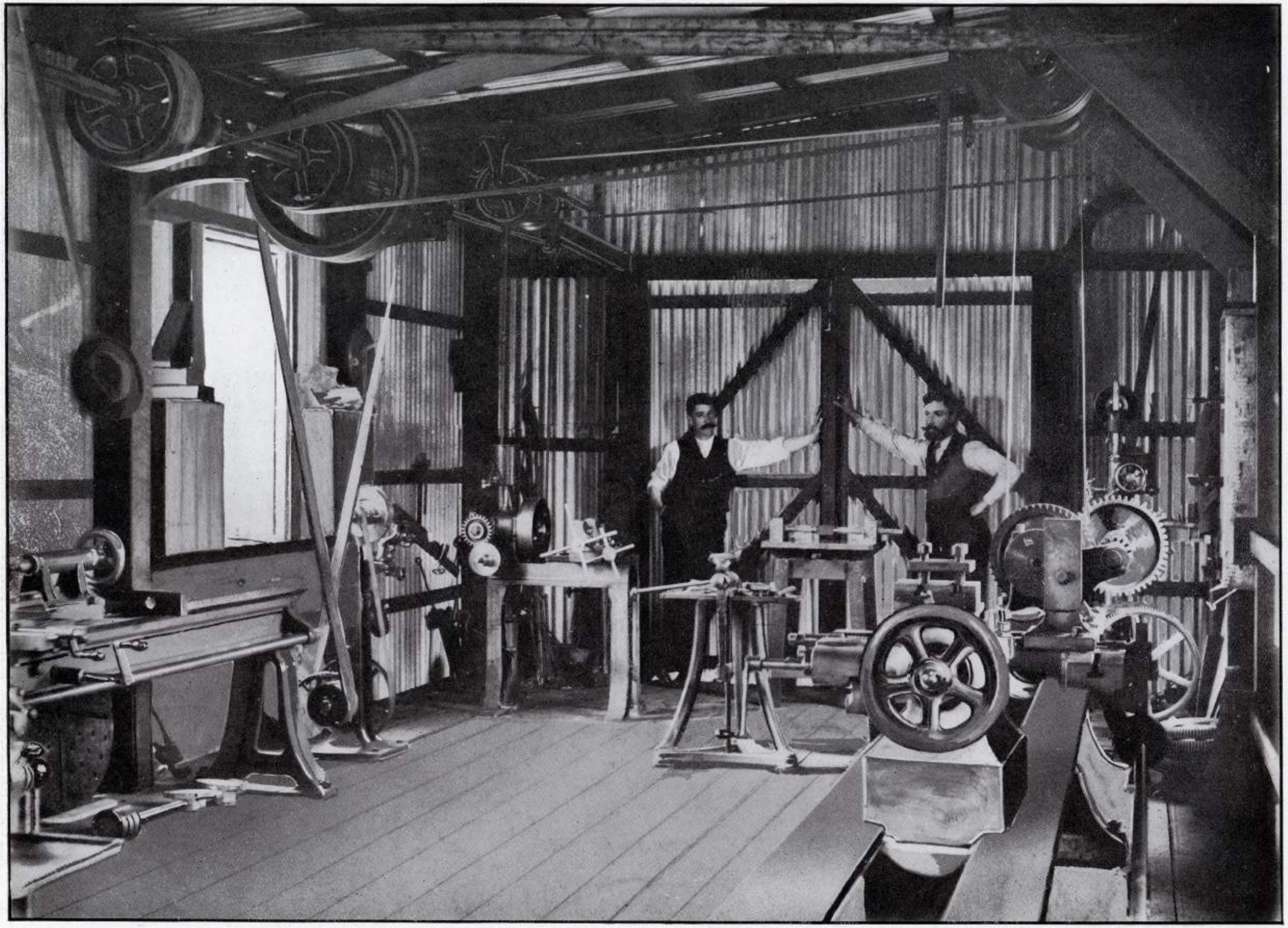
In conclusion, we think that everyone connected with the scheme is to be congratulated on the successful completion of such a gigantic task, and it is to be deeply regretted that the late Mr. C. Y. O'Connor did not live to see its completion, as the successful working of the scheme is largely due to his engineering abilities. The fact that the whole scheme was started and the water



GENERAL WORKSHOP AND STORE, No. 3 PUMPING STATION.



INTERIOR OF WORKSHOP, No. 3 PUMPING STATION.



INTERIOR OF WORKSHOP, No. 3 PUMPING STATION.

pumped through to Kalgoorlie without a single accident, and that the scheme has now been working for nearly two years without any serious accident (the number of minor troubles being extremely small considering the enormous size of the undertaking) is one that Messrs. James Simpson & Co., Limited, will naturally feel proud of, and the successful handling of so large an amount of water, through a pumping main of such magnitude, more than confirms the wisdom of the decision on the part of the West Australian authorities to select the Worthington design for their pumping machinery

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